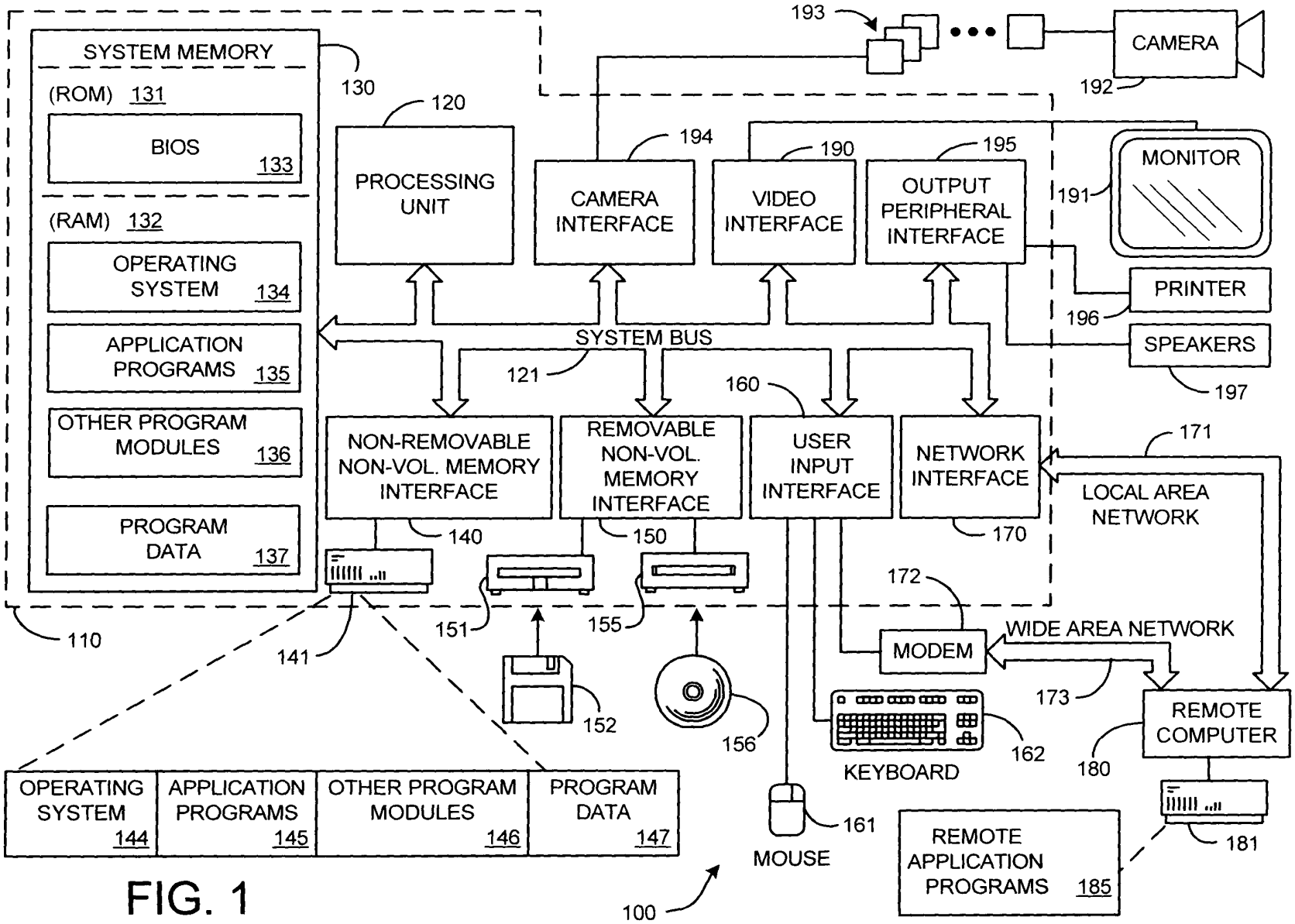

SYSTEM MEMORY
130
(ROM) 131
BIOS 133
(RAM) 132
OPERATING SYSTEM 134
APPLICATION PROGRAMS 135
OTHER PROGRAM MODULES 136
PROGRAM DATA 137
120
PROCESSING UNIT
193
CAMERA
192
194
CAMERA INTERFACE
190
VIDEO INTERFACE
195
OUTPUT PERIPHERAL INTERFACE
MONITOR
191
PRINTER
196
SPEAKERS
197
SYSTEM BUS
121
160
NON-REMOVABLE NON-VOL. MEMORY INTERFACE
REMOVABLE NON-VOL. MEMORY INTERFACE
USER INPUT INTERFACE
NETWORK INTERFACE
171
LOCAL AREA NETWORK
140
150
170
110
141
151
155
172
WIDE AREA NETWORK
MODEM
173
152
156
162
KEYBOARD
REMOTE COMPUTER
180
161
MOUSE
181
REMOTE APPLICATION PROGRAMS 185
OPERATING SYSTEM 144
APPLICATION PROGRAMS 145
OTHER PROGRAM MODULES 146
PROGRAM DATA 147
100

FIG. 1

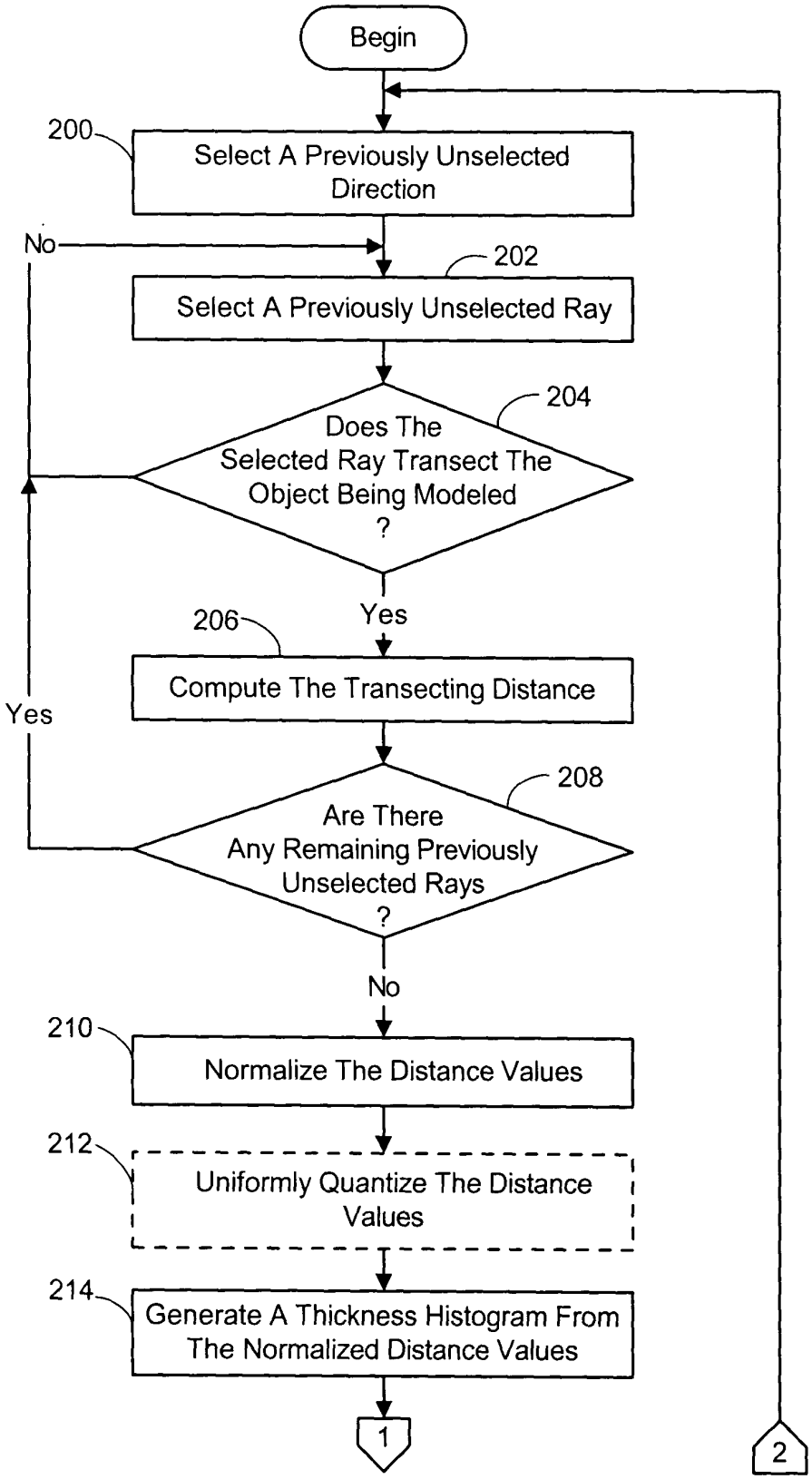

Begin
200
Select A Previously Unselected Direction
No
202
Select A Previously Unselected Ray
204
Does The Selected Ray Transect The Object Being Modeled ?
Yes
206
Compute The Transecting Distance
Yes
208
Are There Any Remaining Previously Unselected Rays ?
No
210
Normalize The Distance Values
212
Uniformly Quantize The Distance Values
214
Generate A Thickness Histogram From The Normalized Distance Values
1
2

FIG. 2A

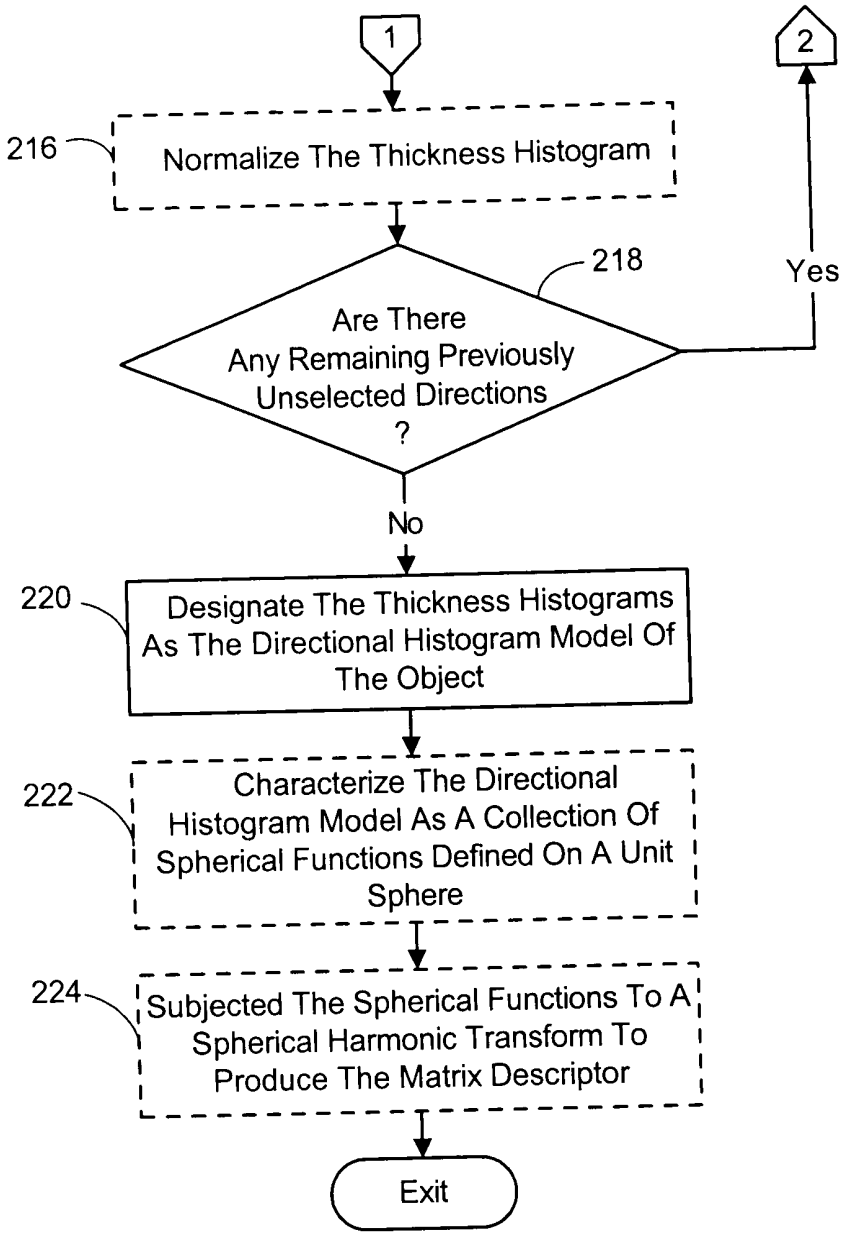

1
2
216
Normalize The Thickness Histogram
218
Are There Any Remaining Previously Unselected Directions ?
Yes
No
220
Designate The Thickness Histograms As The Directional Histogram Model Of The Object
222
Characterize The Directional Histogram Model As A Collection Of Spherical Functions Defined On A Unit Sphere
224
Subjected The Spherical Functions To A Spherical Harmonic Transform To Produce The Matrix Descriptor
Exit

FIG. 2B

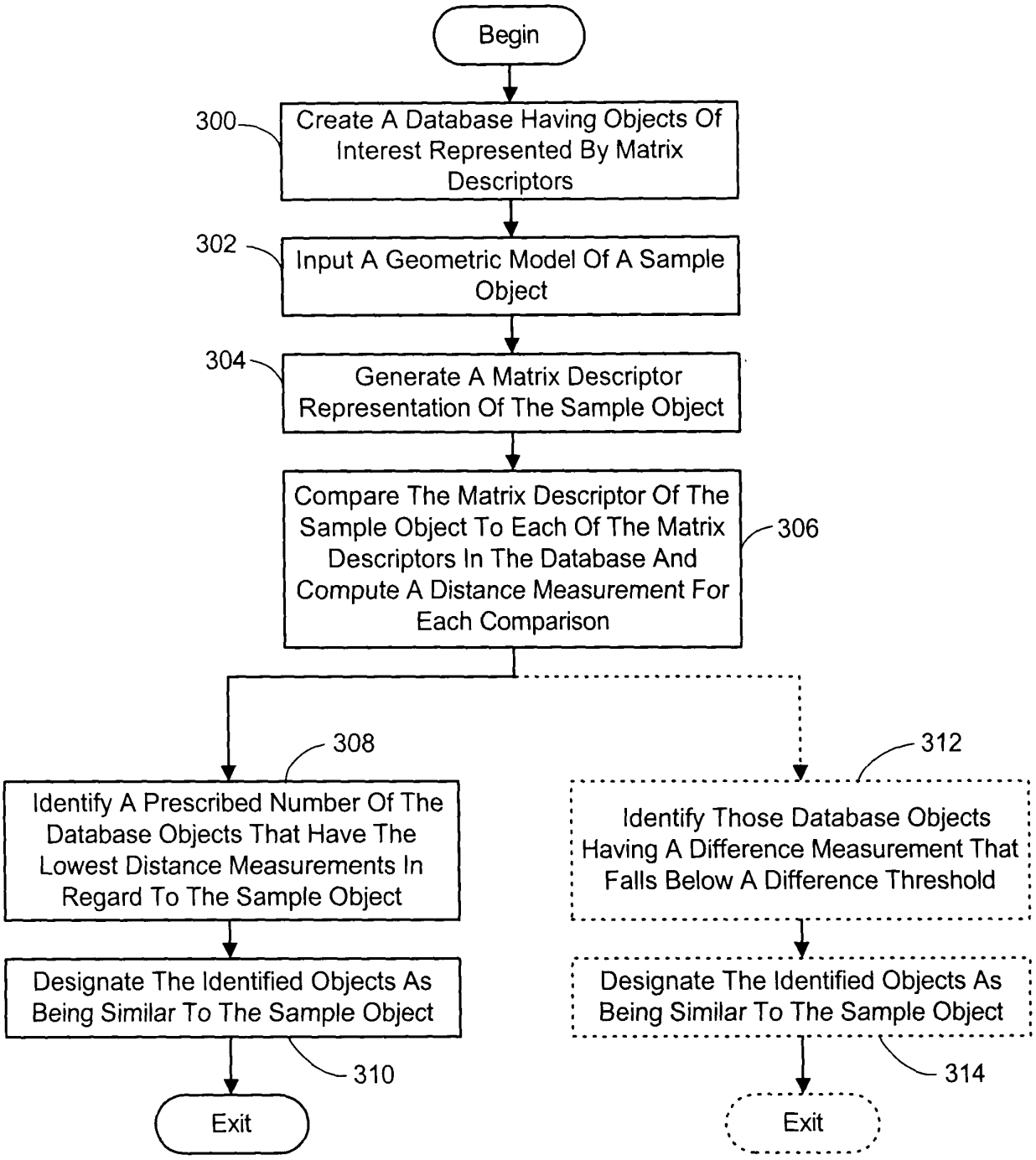

Begin
300
Create A Database Having Objects Of Interest Represented By Matrix Descriptors
302
Input A Geometric Model Of A Sample Object
304
Generate A Matrix Descriptor Representation Of The Sample Object
Compare The Matrix Descriptor Of The Sample Object To Each Of The Matrix Descriptors In The Database And Compute A Distance Measurement For Each Comparison
306
308
Identify A Prescribed Number Of The Database Objects That Have The Lowest Distance Measurements In Regard To The Sample Object
Designate The Identified Objects As Being Similar To The Sample Object
310
Exit
312
Identify Those Database Objects Having A Difference Measurement That Falls Below A Difference Threshold
Designate The Identified Objects As Being Similar To The Sample Object
314
Exit

FIG. 3

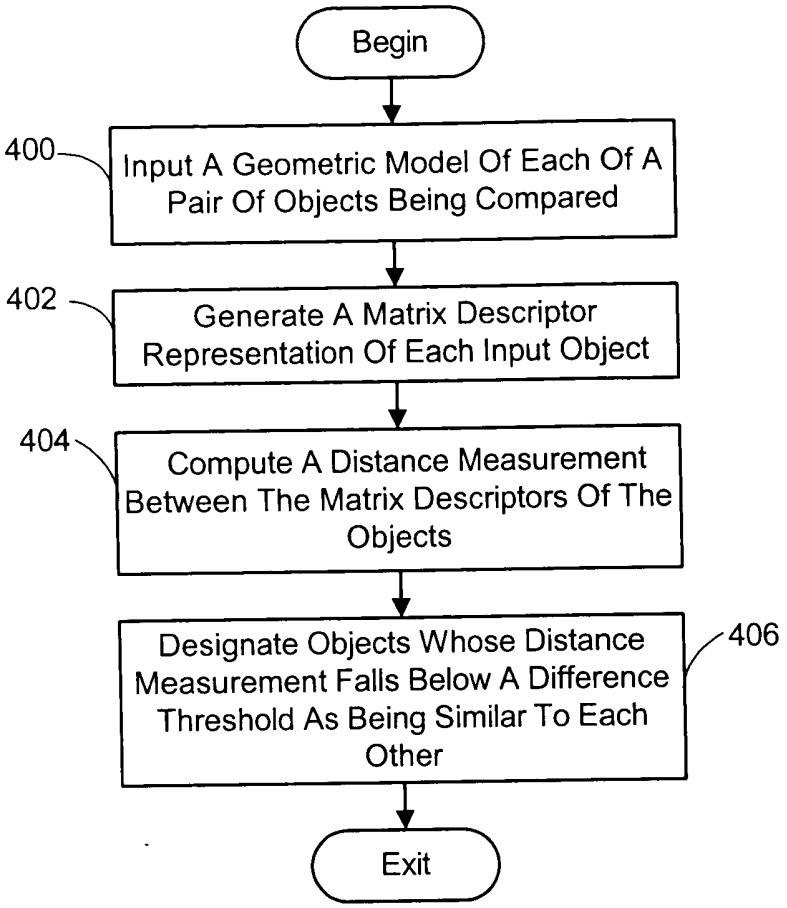

Begin
400
Input A Geometric Model Of Each Of A Pair Of Objects Being Compared
402
Generate A Matrix Descriptor Representation Of Each Input Object
404
Compute A Distance Measurement Between The Matrix Descriptors Of The Objects
Designate Objects Whose Distance Measurement Falls Below A Difference Threshold As Being Similar To Each Other
406
Exit

FIG. 4

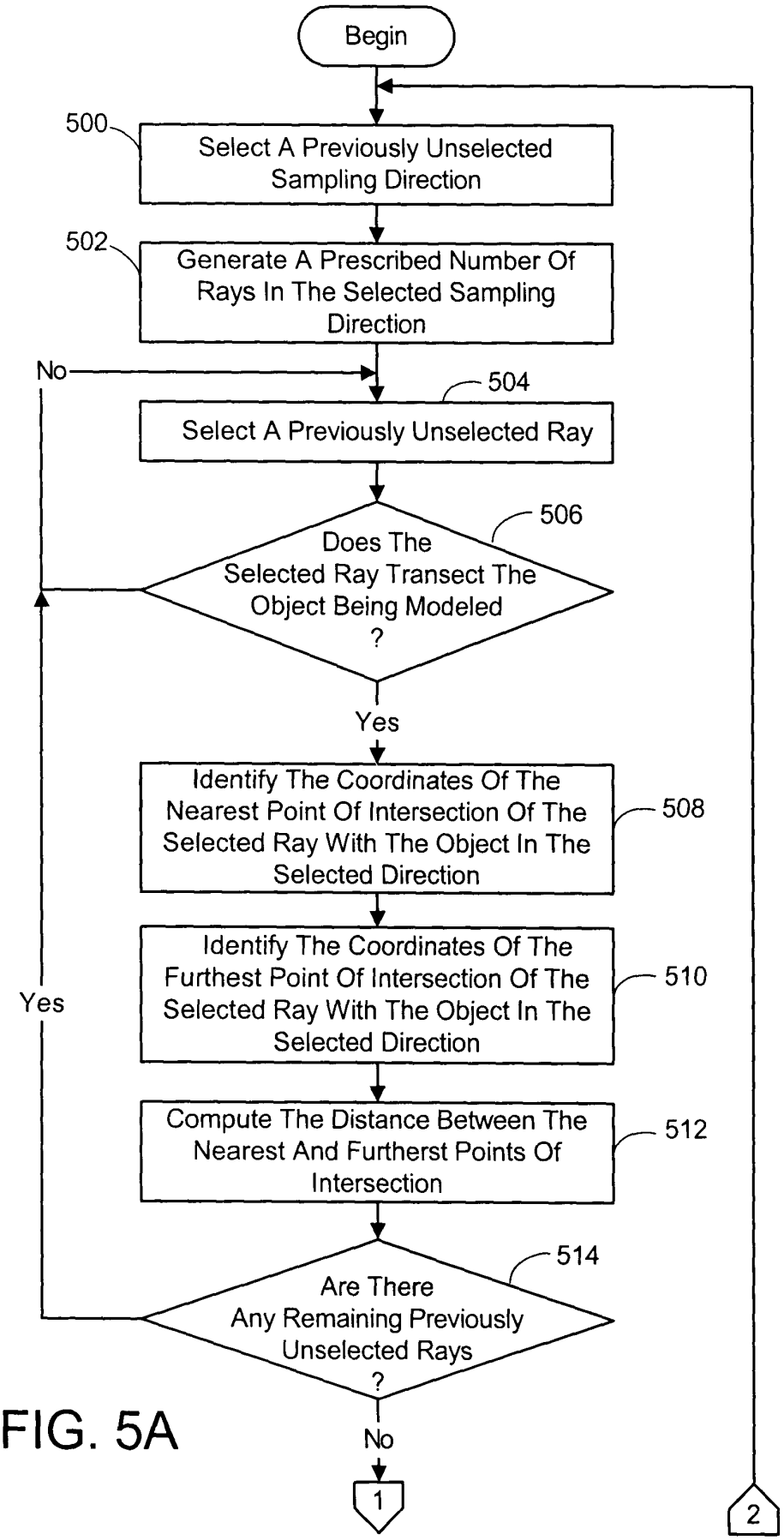

Begin
500
Select A Previously Unselected Sampling Direction
502
Generate A Prescribed Number Of Rays In The Selected Sampling Direction
No
504
Select A Previously Unselected Ray
506
Does The Selected Ray Transect The Object Being Modeled ?
Yes
Identify The Coordinates Of The Nearest Point Of Intersection Of The Selected Ray With The Object In The Selected Direction
508
Identify The Coordinates Of The Furthest Point Of Intersection Of The Selected Ray With The Object In The Selected Direction
510
Yes
Compute The Distance Between The Nearest And Furtherst Points Of Intersection
512
514
Are There Any Remaining Previously Unselected Rays ?
No
1
2

FIG. 5A

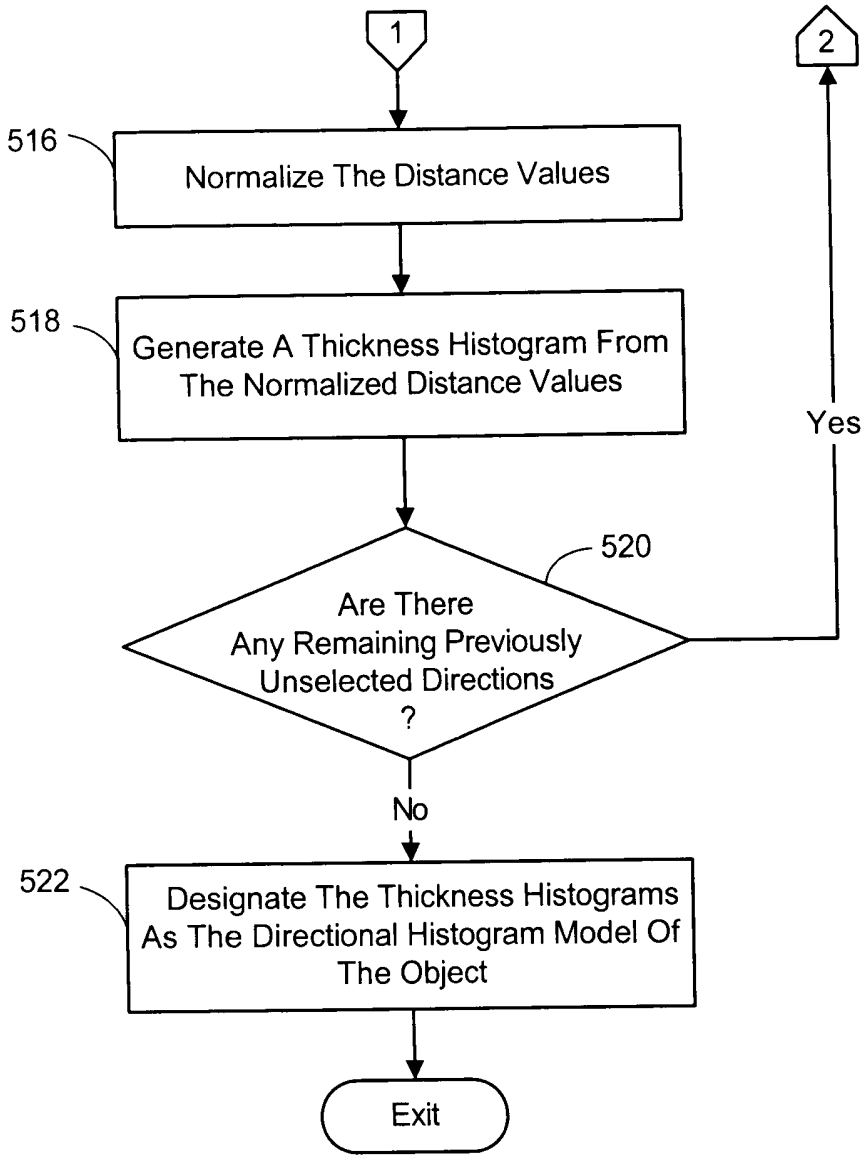

1
2
516
Normalize The Distance Values
518
Generate A Thickness Histogram From The Normalized Distance Values
520
Are There Any Remaining Previously Unselected Directions ?
Yes
No
522
Designate The Thickness Histograms As The Directional Histogram Model Of The Object
Exit

FIG. 5B

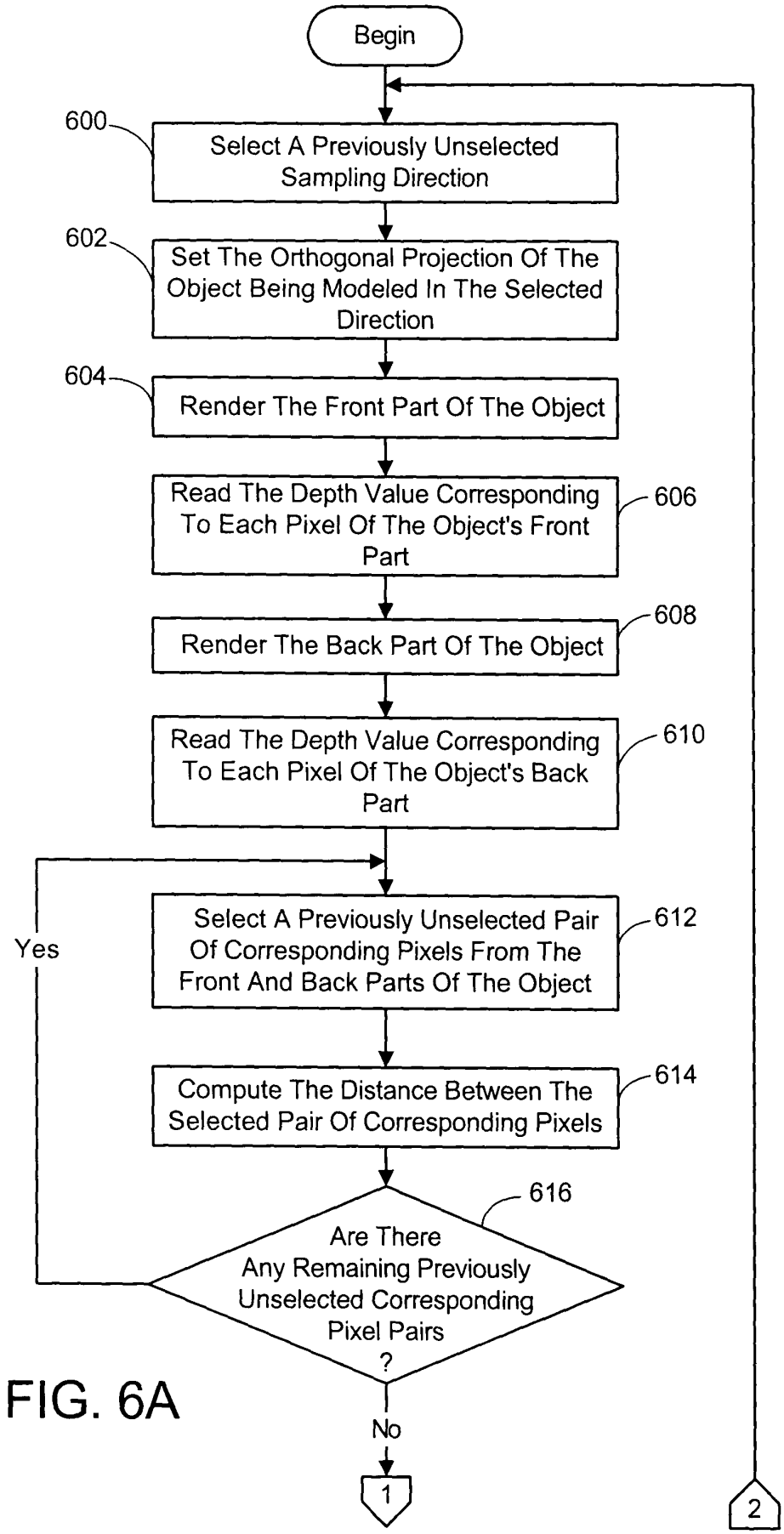

Begin
600
Select A Previously Unselected Sampling Direction
602
Set The Orthogonal Projection Of The Object Being Modeled In The Selected Direction
604
Render The Front Part Of The Object
Read The Depth Value Corresponding To Each Pixel Of The Object's Front Part
606
Render The Back Part Of The Object
608
Read The Depth Value Corresponding To Each Pixel Of The Object's Back Part
610
Select A Previously Unselected Pair Of Corresponding Pixels From The Front And Back Parts Of The Object
612
Yes
Compute The Distance Between The Selected Pair Of Corresponding Pixels
614
Are There Any Remaining Previously Unselected Corresponding Pixel Pairs ?
616
No
1
2

FIG. 6A

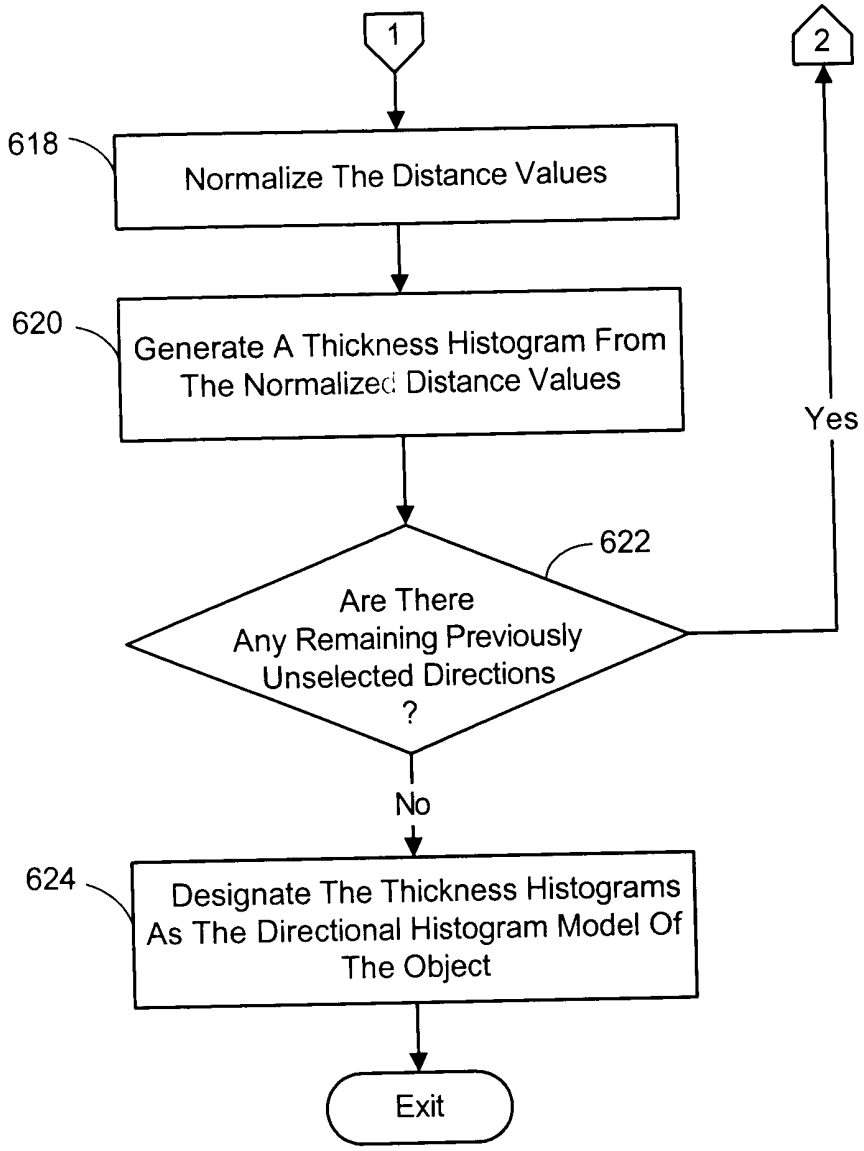

1
2
618
Normalize The Distance Values
620
Generate A Thickness Histogram From The Normalized Distance Values
622
Are There Any Remaining Previously Unselected Directions ?
Yes
No
624
Designate The Thickness Histograms As The Directional Histogram Model Of The Object
Exit

FIG. 6B

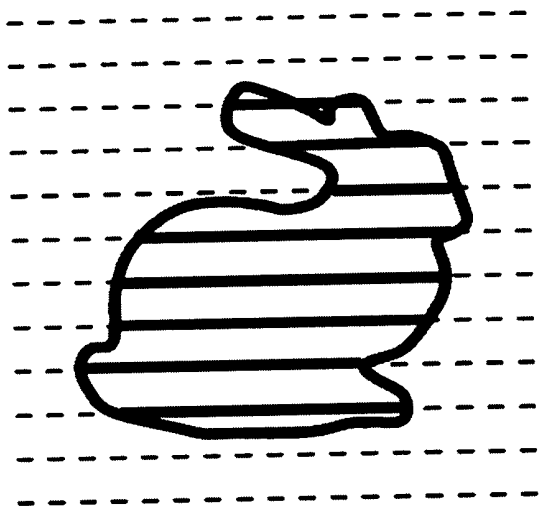


FIG. 7(a)

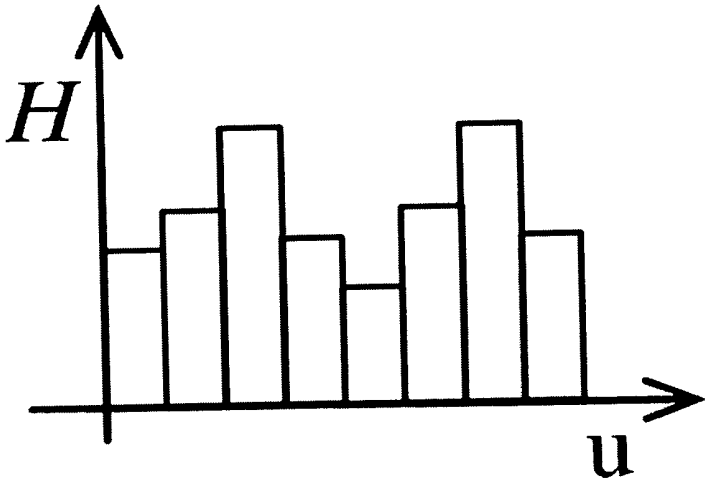


FIG. 7(b)

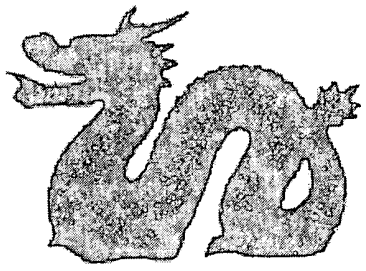


FIG. 9(a)

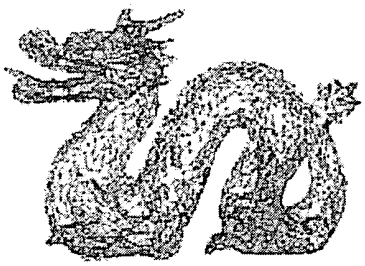


FIG. 9(b)

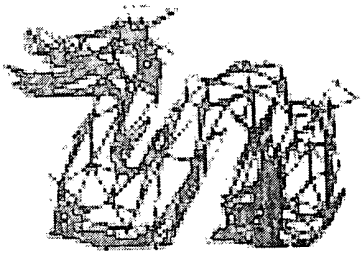


FIG. 9(c)

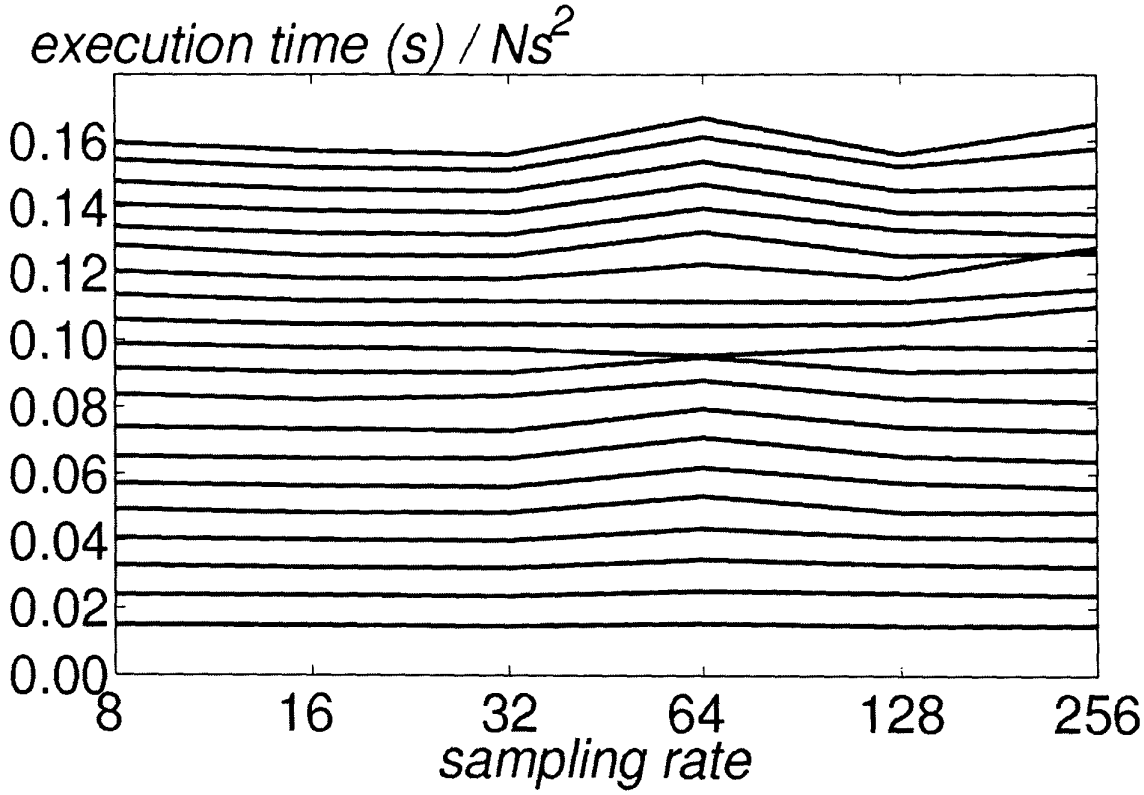

execution time (s) / Ns2
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
8
16
32
64
128
256
sampling rate

FIG. 8(a)

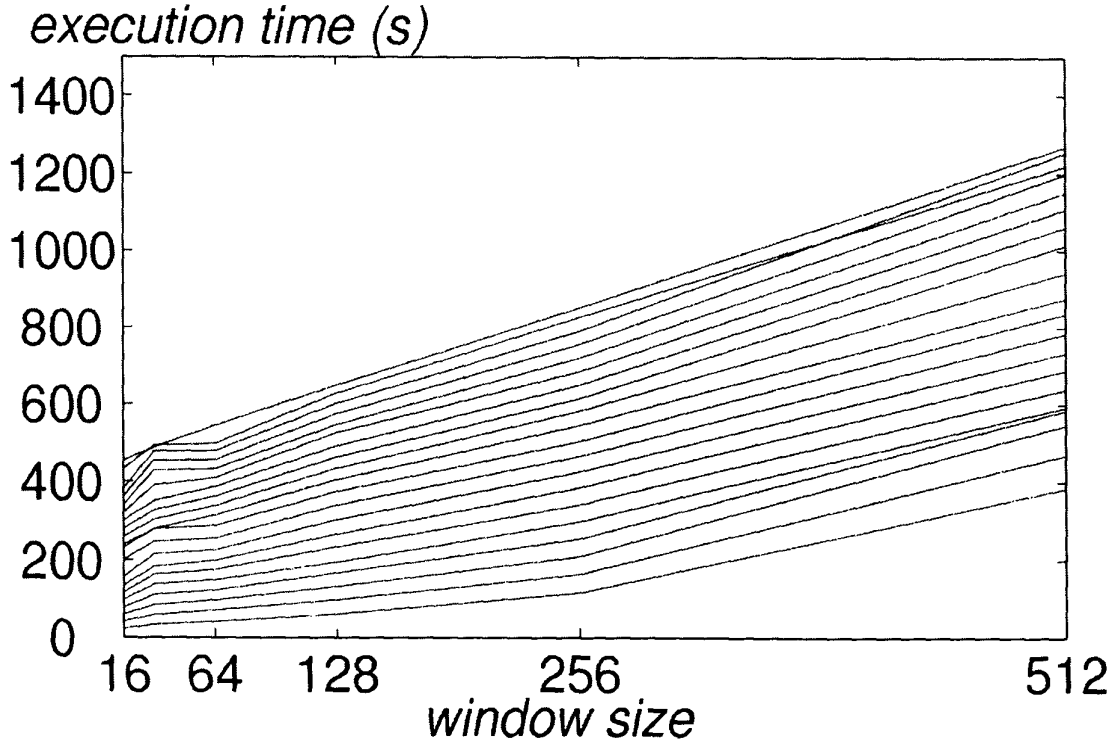

execution time (s)
1400
1200
1000
800
600
400
200
0
16
64
128
256
512
window size

FIG. 8(b)

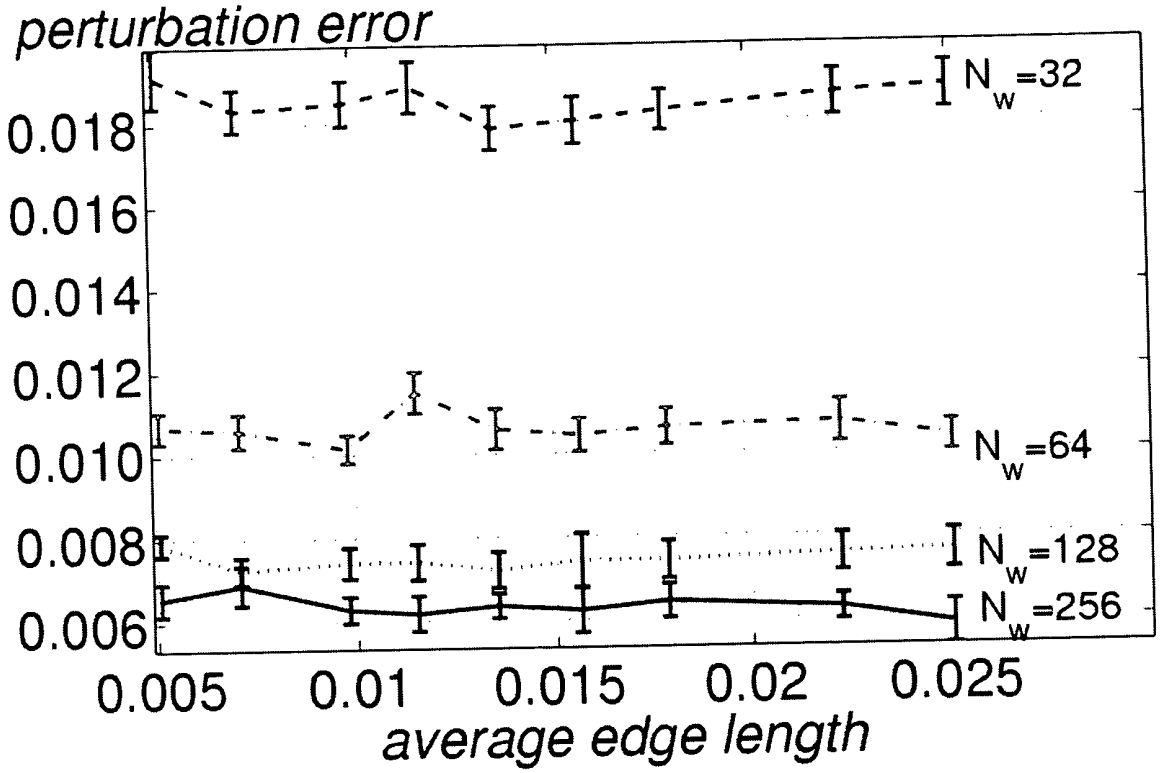


FIG. 10(a)

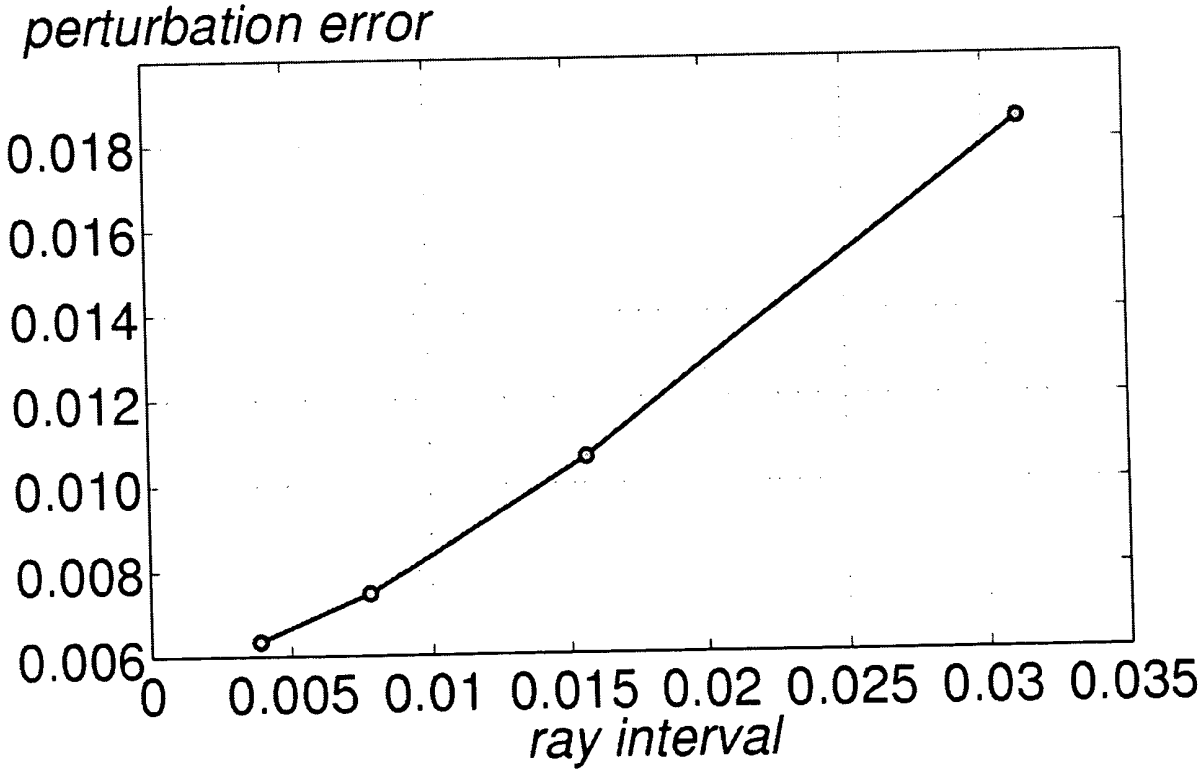


FIG. 10(b)

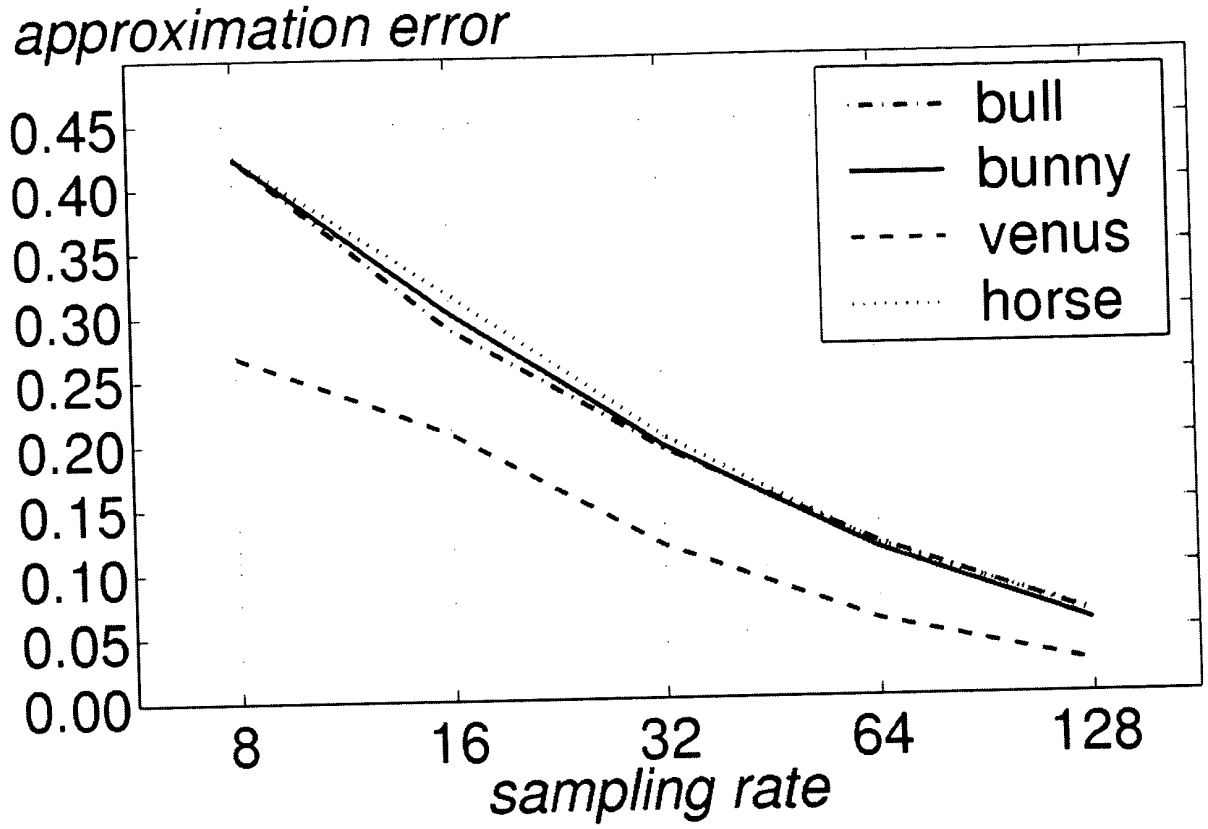


FIG. 11(a)

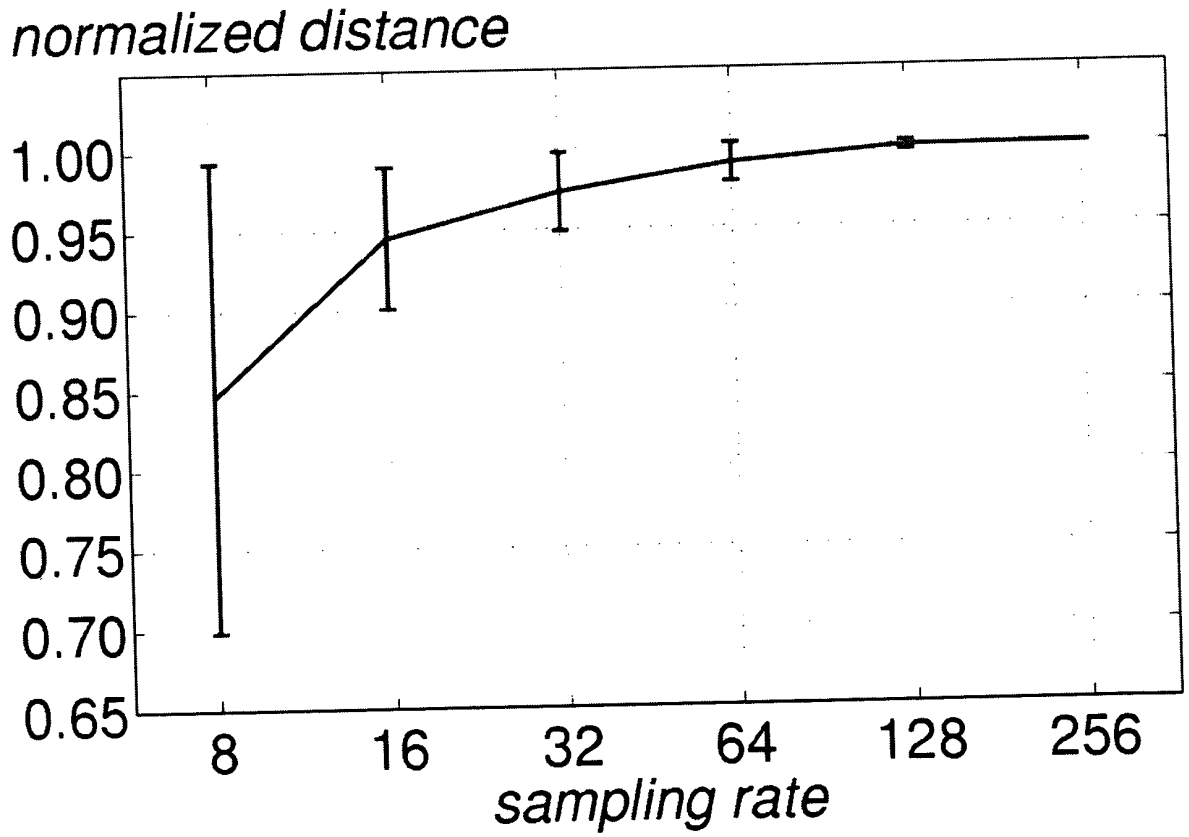


FIG. 11(b)

TABLE 1

$N_s = 16$	10°	20°	30°	40°	50°
ball	0.001	0.002	0.004	0.003	0.003
venus	0.002	0.015	0.013	0.013	0.013
bunny	0.002	0.003	0.004	0.005	0.007
horse	0.031	0.043	0.043	0.039	0.035
bull	0.007	0.006	0.012	0.019	0.018
$N_s = 64$	10°	20°	30°	40°	50°
ball	0.001	0.001	0.002	0.001	0.001
venus	0.004	0.005	0.005	0.004	0.003
bunny	0.011	0.015	0.014	0.007	0.007
horse	0.016	0.021	0.021	0.013	0.013
bull	0.011	0.013	0.014	0.009	0.009

FIG. 12

TABLE 2

	0.000	**0.353**	0.780	1.029	1.049
	0.353	0.000	0.525	0.831	0.846
	0.780	0.525	0.000	**0.434**	0.449
	1.0289	0.8311	0.4341	0.0000	**0.352**
	1.049	0.846	0.449	**0.352**	0.000

FIG. 14

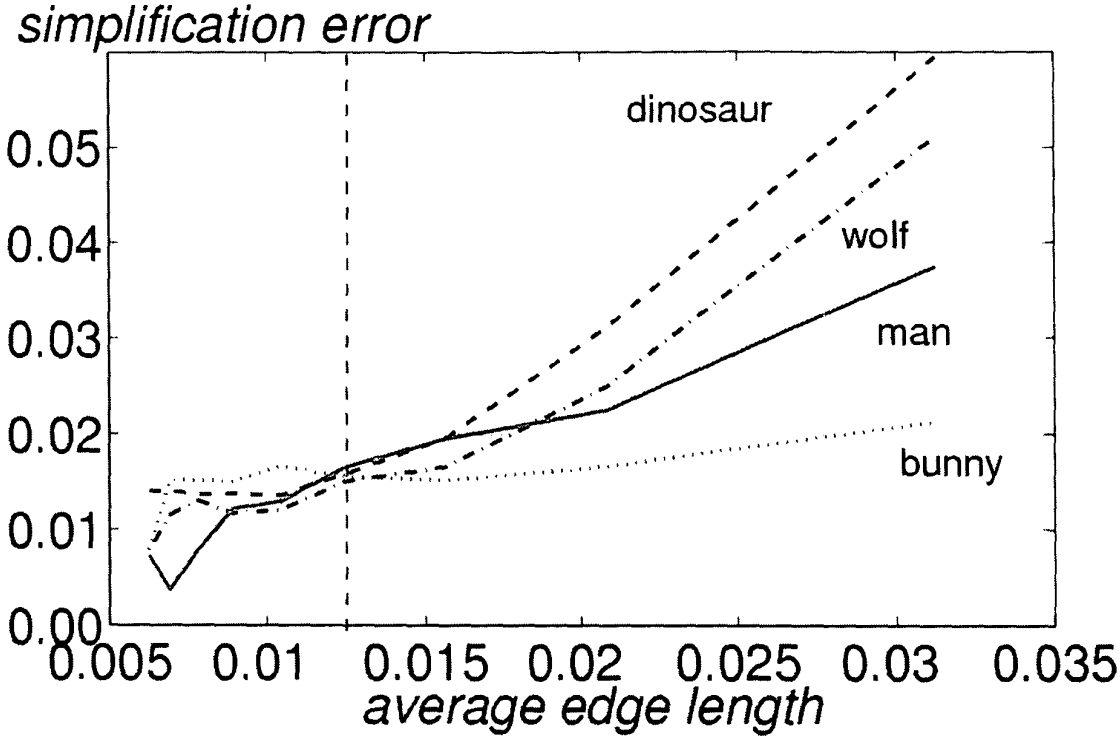
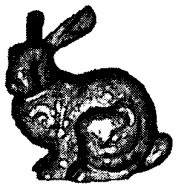


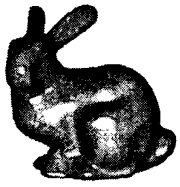
FIG. 13

FIG. 15(a)



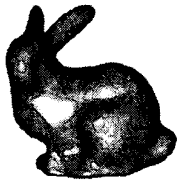
(a) 0.00

FIG. 15(b)



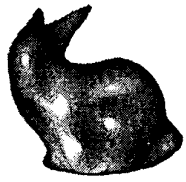
(b) 0.085

FIG. 15(c)



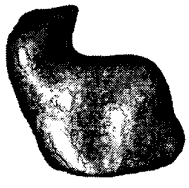
(c) 0.112

FIG. 15(d)



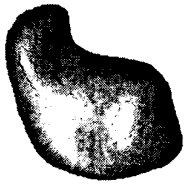
(d) 0.189

FIG. 15(e)



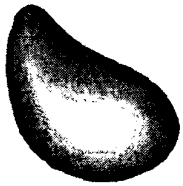
(e) 0.321

FIG. 15(f)



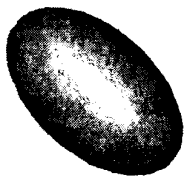
(f) 0.419

FIG. 15(g)



(g) 0.570

FIG. 15(h)



(h) 0.781

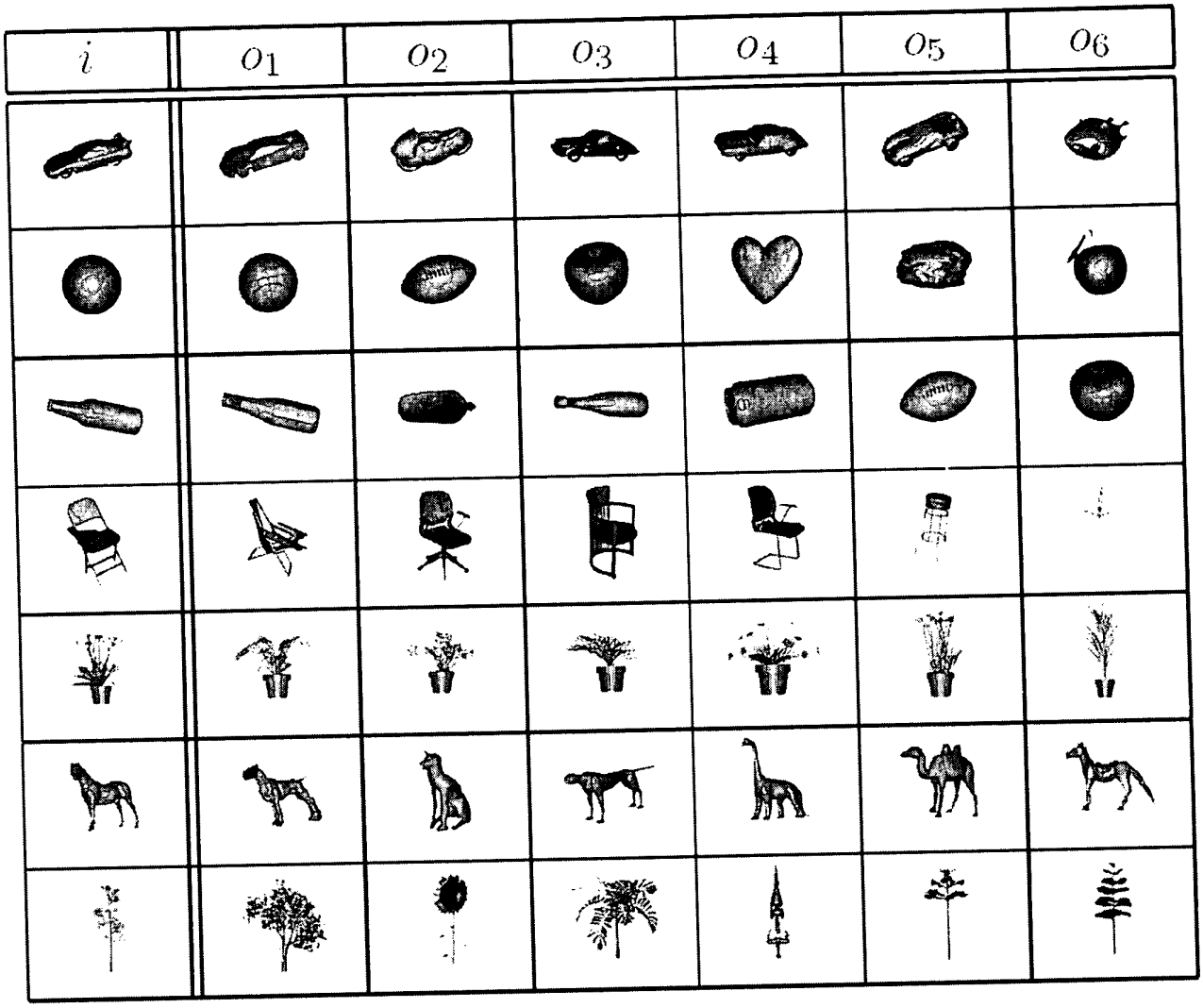


FIG. 16